Journal of the Society of Arts.

FRIDAY, DECEMBER 28, 1855.

EXTRA-ORDINARY MEETING.

Friday, December 21, 1855.

An Extra-Ordinary Meeting was held on Friday evening, the 21st instant, for the purpose of resuming the Discussion upon Mr. Bailey Denton's paper "On the Under-drainage of Land." P. L. Simmonds, Esq., presided, in the absence of C. W. Hoskyns, Esq., who took the chair on the last occasion, but was unable to do so in the present instance, owing to his official duties, as High Sheriff of Warwickshire, calling him into the country.

RENEWED DISCUSSION ON THE UNDER-DRAINAGE OF LAND.

The Secretary stated that he had received communications from Messrs. Arkell, Bazalgette, Beattie, Blamire, and Girdwood, on the subject before the meeting, which it was desirable should be read before the discussion was re-opened.

Mr. Thomas Arkell said :—

"The principal object I had in view in attending your meeting of the 12th inst., was to assist in correcting two errors in the drainage of land, which I consider to have been attended with the greatest disappointment for several years past, and will continue to be if still persevered in.

"These are using small pipe tiles as at present made, and not putting the drains in the furrows on arable land, more especially on clay soils. These I consider to be the great evils of the present day, though not so at the time I wrote my "Essay on Draining," in 1843. The great evil then was the extreme shallowness of the draining, being but 1 foot, 16 inches, 18 inches, and 2 feet deep, seldom more than the latter, that being then considered deep draining. This error has been generally, though not wholly, remedied, and, if anything, gone too much to the extreme the other way. Still, I do not think the harm has arisen so much from the drains being put in deep, as from using too small pipes.

Pipe-tiles were scarcely known in 1843, except in an isolated district or two, so that I said nothing respecting them; but in the same Journal, Vol. 4, part 2nd, of the Royal Agricultural Society, in which my essay appeared, there is a report of Mr. Parkes, "On Drain-tiles and Drainage." It will be seen there that they were originally made 3 inches in diameter, by bending the clay over a round stick, consequently leaving a narrow slit the whole length of the pipe, which was then thought necessary to admit the water. These were found to act well. He then gives an account of the pipe-tile machine, and of land drained with pipes of one inch diameter, which was said to answer well; and no doubt it did, that being the first winter after its execution. This appears to have been the commencement of draining with pipes of so small a diameter as one inch. The next year, in 1844, the show of the Agricultural Society was held at Southampton, which I attended, and there saw Clayton's and other pipe and tile machines at work, and I almost wished I had not been so fast in draining my land, seeing tiles could be made so much cheaper by machinery than I had been having them made by hand. However, in the year 1846, I had drained a few acres with 1¼-inch pipes, about 3 feet deep, and 21 to 25 feet apart up the furrows; the ridges were not very high; they might be nearly one foot higher than the furrows. The drains acted well, and the land was tolerably dry and healthy for the first few years, but afterwards, in wet seasons, it was very wet, and appeared full of water, like undrained land, although at the same time all the drains were running, but very slowly. The land lying favourably for the purpose, each drain emptied itself into an open ditch, so that I could see each one separate.

"About that time, seeing by the newspapers that other parties who had drained their land with small pipes were suffering in the same way, it was recommended to have air drains at the top, or, open each one to the surface to admit air. I acted on the former plan, and put a much larger pipe, a 2-inch one I think it was, along at the top of the piece, and run every furrow drain into it. This had little if any effect, as in the wet seasons of 1852 and 1853 —it was very wet and soft, not in spots, as if some of the drains were at fault, but generally over the piece; then, again, in the dry season of 1854 the land was in a very healthy state, thus showing the drains to be sound and in good condition.

"Now, seeing the drains are sound, but that after heavy rain they do not discharge to anything like their full capacity, I should say not above one-eighth at most, and that they continue running a great length of time after the rain has ceased, although it is not springy land, I have come to the conclusion that the water cannot enter at the joints sufficiently fast to keep it from rising above the pipes. And if the rain is of long continuance it fills the soil to the surface, which is for a time as wet as though there were no drains in it; this, of course, on clay soils, forms a mud round the pipes, and the water entering the drains naturally carries the mud with it into the crevices by which the water enters, and stops them up. Such being the case, it must be also plain that the deeper the drains are put in, the more danger in the joints silting up, from the greater amount of pressure against them. The pressure due to a head of water of 4 or 5 feet, may be imagined from the force with which water will come through the crevices of a hatch with that depth of water above it. Now there is the same pressure of water to enter the vacuum in the pipe-drain as there is against the hatches, supposing the land to be full to the surface.

"This difficulty of the water entering the pipes in so small a space, was seen by some at the time of their introduction, but the idea was pooh-poohed and ridiculed by a few of the clever ones; in fact, some went so far as to say, if there were no joints at all, the pipes would drain the land through their pores; and others said, let anyone try to carry water inside them any distance, and see what difficulty there would be; but carrying water inside is a very different thing, as the pressure would then be reversed, being from the inside. But to return to the hatches or floodgates. What does the miller do in times of drought, when he is in want of every drop of water for his mill? He does not get below the hatches, and plaster a little clay against the crevices to stop the water; that would be about the same thing as trying to carry water in a pipe-drain with the clay outside to keep it in; but he gets a shovelfull of coal ashes, and puts them in above the hatches to stop the leakage, and this has the desired effect. Now, if coal ashes will stop water, is it not plain there is danger in clay and sand stopping it under the same pressure, and the smoother and better the pipes are made, and the closer the joints fit, the more likely they will be to get stopped.

"What I should suggest as a remedy, would be to return to the slit in the pipe, say one-eighth of an inch wide, of a dovetail shape, with the widest opening inside the pipe. This would prevent the mud or sediment withstanding the pressure of the water, and would not be wide enough to allow mice to enter; and, in the inch pipes, it would give nearly four times the space for the water to enter that there is at present, and in two-inch pipes it would be twice as much. This opening in the side would not be necessary in the large-sized pipes used for the main

drains, but in all those used for the furrows I think it would act beneficially. Of course it is most requisite in the smaller sizes, say all under two inches diameter.

"The extract of a letter, read by Mr. Denton, from Mr. Macvicar, of Lincolnshire, describes an exactly parallel case to my own, and, I have no doubt, the failure was caused by the inability of the water to enter the drains; for where I have used the horse-shoe tiles (with which the principal part of my drainage is done) they act as well now as when first put in.

"Putting the parallel drains at equal distances apart, regardless of the furrows, I consider a very great evil, especially where the lands or ridges have been gathering up for a great number of years, and are too high to be levelled without injury to the soil, or without going to a considerable expense.

"It will be admitted, I think, on all hands, that at times we have heavy rains, and of such long continuance that clay soils will not admit the rain as fast as it falls, and that this occurs much oftener on land drained with pipe-tiles than on that where the horse-shoe tile is used, so that the rain runs on the surface into the hollows and low places, and if the drains are not placed in the furrows or under these low places, it will lay sufficiently long to kill the wheat or any other crops that are planted. Putting the drains in the furrows, which are the low places, appears so reasonable, and carries such a common-sense view of the case with it, that to argue in its favour must appear to many altogether unnecessary and absurd, were it not that the contrary is upheld and acted on by many of those who are classed amongst the greatest authorities on draining of the present day. Is it not reasonable and common-sense, that when you want the most water to run off in the shortest time, it should have the least distance to run. Suppose the drain to be only half-way up the side of the ridge (some, of course, would be under the tops of the ridges where they are of irregular widths), but suppose them to be only half-way up the side, in these hasty rains the water would run from the whole side of the ridge to the furrow, and then it would have to filter or percolate back again through the subsoil to the drain; and this is not the worst of the evil,—when the land is drained, and the drains act properly, the water table is lowest at the drains, and highest midway between them, and this water-table rises and falls between the drains according to the quantity of rain; so that where the land ought to be in the best state to receive the water it is in the worst, from the water table being nearest the surface,—and, again, when it is in the worst state to receive water, that is in very wet times, there is most to receive, when, of course, if there is no outlet or open furrows to take the water from the surface, it stands and makes itself a bed of mud, which will hold it long after he subsoil is dried by the drains.

"Instead of putting the drains in at equal distances, supposing the ridges are too wide for one drain to be sufficient, I should say there are two ways to act, either put one half-way up the side of the ridge as well as one in the furrow, tor, which I think better, gather up a rather low narrow ridge in the old furrow, and put a drain on each side of it, in the new made furrows, keeping the land rather lowest over the drains. I have not mentioned any cases of failure to support my arguments except my own, as it is far from my wish to expose and injure any individual, but if any parties who may read my remarks, shall be able to explain any failure in their draining, and profit thereby, I shall be satisfied for the little trouble I have taken in the matter.

"After hearing the discussion of the 12th instant, I would beg to say that my remarks are meant to apply most particularly to the flat uniform clays and limestone soils that are in tillage, as the slow drainage of the pipes on grass lands may be advantageous; and that the opening in the side of the pipes may be objectionable on sandy soils, where they are apt to silt up, but on our Oxford clay and the calcareous clays of the oolites, I have never had any drains silted up, although they have been laid in from 12 to 15 years.

"With respect to Mr. Trimmer and the Keythorpe system, where there are subterraneous ridges and furrows, it is obviously right to cut across them, as the result has shown, but I am inclined to think that these are exceptional cases, and that the rule is to keep the greatest descent, and in the surface furrows.

"Mr. Thompson said, it had never been satisfactorily explained to him why the deepest drains sometimes ran sooner than the shallow ones, and sometimes not; I can easily account for it to my own satisfaction, but to explain it we must refer to the water table, or, as some people call it, the stagnant water in the soil.

"To hear some people talk on the benefits to be derived from drainage, and the injury to plants where the land is undrained, one would almost suppose the water table was always within a few feet or inches of the surface, but such is not the case. Let any one refer to a little pamphlet by the Rev. J. C. Clutterbuck, on the "Drainage and Replenishment of the Subterraneous Reservoir in the Chalk Basin of London," and he will there see how the springs and outlets are continually and gradually lowering the water table in the chalk, as soon as the wet season has passed, and although the water table may reach the surface in the height of the rainy season, that for nearly the whole of the vegetating and ripening seasons it is very many feet below. Also on the level clay land, the water table is reduced by evaporation through the spring, summer, and autumn months, probably from 10 to 20 feet below the drains, according to the dryness of the seasons. It may be more or less, but it could easily be ascertained by boring in the autumn. But, for argument sake, I will suppose it falls 10 feet below the surface. The first rains in the fall of the year are taken up by the dried soil and subsoil. It may take, probably, two inches of rain to saturate the land, if it falls steadily, without raising the water-table, and consequently not making the drains run. Now, supposing the soil fully saturated down to the water-table, the first rain, in excess of this, begins to raise the water. It is possible, I think, for one inch of rain then to raise the water-table from 10 to 20 feet, or more, in a clay soil, where the pores are so fine that the water rises in the subsoil. It, of course, reaches the deep drains first, which begin to run before it touches the shallow ones. Then, supposing after some continuance of rain it ceases, and both deep and shallow drains have lowered the water table again to their respective depths, as is the case at the present time in Wiltshire, and in the winter season only will it remain at the level of the drains without rain for any length of time, when very little vegetation or evaporation is going on, so that the next rain we have, the drains will immediately run, in consequence of its meeting with the watertable, and, if anything, the shallow ones first, but the difference would be scarcely perceptible."

Mr. J. W. Bazalgette, engineer-in-chief to the Metropolitan Commission of Sewers, said:—

"The discussion on the 12th inst., on Mr. Bailey Denton's able paper, showed very plainly that in spite of all that has been written and spoken on the subject of land-drainage during the last ten years, we still want data for comparing the relative value of pipes at given depths for carrying off rainfall; whereas, upon a number of carefully recorded facts, it would become easy to base sound theories. The terms deep and shallow drainage are vague in the extreme, and we have, at present, no sufficient information as to the real effect of 3 feet, 4 feet, and 5 feet drainage, upon the same and different kinds of soil.

"We want to know, with showers various in density and duration, on different kinds of soil, what proportion of the rain will pass off through the surface channels, and what proportion through the under drains; and whether this latter proportion is greater with deep or shallow drainage? Again, we want to know how soon, after the rain commences, the drains begin to run, and how long

they continue to discharge after the shower is over; comparing the results of the 3 feet, 4 feet, 5 feet, and 10 feet drains in this respect?

"I put out of the question the value of drains 4 feet deep and upwards, for increasing the temperature of the soil.

"Some of the farms already drained must afford excellent opportunities for such observations, the results of which carefully recorded, and collected, cannot fail to be of national benefit. I would, therefore, suggest to those gentlemen who have the opportunities, and are desirous of advancing this science, that a rain-guage should be fixed in a convenient position, near to the outfall drains, and the quantities of rain falling noted every five or ten minutes during heavy storms. A thin plate of tin, or iron, with a rectangular opening at the top, should be placed as a dam across the lower half of each outlet, and the depth of the water flowing over these weirs, at the same time recorded. During uniform and continuous rains, it may be sufficient to make these observations once in every hour. The operation is so simple, that an intelligent and careful farm foreman could, after a short time, be entrusted with it. The required information might be periodically forwarded to the Society of Arts, in the form of tables, similar to, or modifications of, the following specimen:—

Locality.

Description of soil.

Size, depth, and distance between branch drains, whether laid with collars or not; and date of construction.

Number of outfalls, with the diameters and inclinations of each.

Number of acres drained through each outlet (accompanied by a plan, if possible).

Length of rectangular opening or weir.

Date.	Rain.		Time of noting the depth of rain in the guage.	Depth of water in the rain-guage, in inches & decimals.	Period of guaging the discharge at the outfalls, noting the time when it commenced and ceased.	Depth of water at outfall.				General Remarks.
	Commenced.	Ended.				Number 1.	Number 2.	Number 3.	Number 4.	

"These tables will not only show the quantities of water drained out of the soil, and the rapidity with which it is abstracted from it by drains of different depths, after it enters, but they would also become most useful records respecting the phenomena of rainfalls, and their effects upon agriculture.

"Should my suggestions be acted upon, I shall be most happy, in a future letter (for the benefit of non-professional persons) to publish the rules by which the actual quantities of rain falling, and the proportionate quantities carried off by the surface and subsoil-drains, may be calculated; or, so important do I consider the inquiry, I will myself undertake to perform this part of the investigation.

"I may mention, in conclusion, that rain guages may be had in London for about thirty shillings each, with explanations as to their use."

Mr. JAMES J. BEATTIE (of Aberdeen) said—"I have just glanced over the paper in the *Journal* of the 14th, and beg to say that I concur in the views entertained by Mr. Denton. There are several particulars that I should have liked, had time permitted, to lay before the meeting of the 21st, corroborative of the depth of furrow drains not being less than 4 feet, and the effect produced in improving the climate where drainage has been pretty extensively carried out.

"At first (1846) drainage was begun here at shallow depths, but in the course of two years it was gradually carried deeper, until 4 feet was generally adopted at distances apart of 24, 27, and 30 feet, the latter being the greatest distance that I countenanced. I may mention that the sum expended under my directions, arising from loans from government and private outlays by the owners of land, since 1846, is about £200,000.

"The nature of the ground over this and the adjoining counties is exceedingly variable; indeed, it is not unusual in a drain of 6 or 7 chains long, to pass through three or four different descriptions of subsoil. A great part is difficult to cut, from the number of stones and large boulders imbedded in hard gravelly clay. The expense, therefore, is much beyond the cost spoken of by Mr. Denton, being here from £6 to £9 per acre. Pipes and collars are now invariably used by the most experienced drainers.

"I have discontinued trench ploughing immediately after drainage. I observe that the soil when drained subsides in dry periods and expands during wet seasons, so that an action takes place naturally sufficiently strong to break up even the moorband pan which is so frequently met with in this district. This is more apparent where the drains have been deep and not far apart. I have recommended old grass land that had become in its wet state tough in the surface, to be left at least two years unbroken up after being drained. The grass improves in quality, and the land, when afterwards ploughed, is friable and mellow, more easily prepared for cropping, and produces better crops. The saving of labour is also very great, particularly when it comes to be prepared for turnips. The green surface is replaced on the drains and rolled down flat.

"Before adopting 4 feet deep drains, I had much difficulty in dealing with the iron ore which generally appeared at two to three feet from the surface, but by the extra depth the water filters off to the pipes free of ore. Occasionally iron ore is found at a greater depth, but the floating substance is then in most cases lighter, and does not adhere to the pipes in the same way as that found near the surface."

Mr. WM. BLAMIRE (of the Inclosure Office) said, "the Commissioners have no suggestions to offer, but in my private capacity I take the liberty of stating, that I do not think the attention of the public has yet been directed to the important results arising from the system of deep drainage in as forcible a manner as it might be."

Mr. JOHN GIRDWOOD, in a letter addressed to the Chairman of the meeting, said, "that in order to obtain any practical benefits from such discussions, the subject in hand must be much more closely adhered to, and the discussion confined within the limits which Mr. Bazalgette endeavoured in vain to draw attention to on the last evening." He further suggests, "that some such arrangement as the following would be useful:—1st, What are the aims and objects of land drainage, and what have been its results. This is necessary, as there are some important questions involved, which must guide all our future steps, as, for instance, Is drainage of land to be considered as mere water channelling, or has it other aims affecting the quality of the soil? 2nd, What principles ought to guide us in fixing the direction of the drain? 3rd, What depths ought to be used, and on what grounds are they to be fixed, &c."

Mr. T. SCOTT, on being called upon by the Chairman, said—After fifteen years' constant connexion with the execution of extensive works of land drainage, watching the results of our various practices, and reasoning on the principles by which those practices were guided, he thought we had arrived at a sound solution of the problem, as to what constituted thorough and permanent drainage, based on the theory of Mr. Josiah Parkes. Mr. Smith of Deanston's practice had, shortly before Mr. Parkes's time,

superseded the wayward operations of local districts to such an extent as to have become almost a national system, causing the expenditure of hundreds of thousands of pounds, not altogether unprofitably, but still without a principle to guide it, for it appeared to him (Mr. Scott) that Mr. Smith never had got hold of one. About ten years ago, Mr. Parkes brought reasoning to our aid, and showed how dependent the effectiveness and permanency of drainage (the latter especially) was, upon the application of sound principles in its execution. Smith's teaching ceased to be followed; much drainage executed according to his rule, became effete, and was taken up and replaced by deeper drains; time confirmed the practice, and now, when we were settling down to our work with a satisfactory confidence, our equanimity was suddenly disturbed by the rise of the "Keythorpe system" of Lord Berners. He had read Mr. Trimmer's paper on this system in the *Journal of the Royal Agricultural Society*, and had heard Lord Berners's verbal explanations, but he was still at a loss to know if it was of national application, or simply adapted to the locality in which it was practised. Even there, we had not had its application guaranteed to us as a *permanent improvement* by an authoritative report from the Enclosure Commissioners, or other recognised public functionaries. He had never in his practice met with such a geological formation as was said to exist at Keythorpe, except in such large areas as to admit of their being drained in the usual *gridiron*, or parallel fashion. As economy was one of its features, we had every inducement, however, to study its merits, and to avail ourselves of the invitation his lordship has so liberally given us to make a personal inspection. In 1838 he (Mr. Scott) served his apprenticeship to land draining on the farms of Mr. John Dudgeon, in West Lothian, and in that and the two following years superintended the execution of 140 miles of drainage, executed at Mr. Dudgeon's own expense, as a tenant on the farms of Almondhill and others, on the principle recommended and then practised by his friend Mr. Smith, of Deanston. These drains were dug 27 and 30 inches deep, the conduits being formed by 2½-inch tiles and soles, or 12 inches of stone broken to pass through a 2½-inch ring. The effect of this drainage was wonderful and repaying at the time; but when he wrote to Mr. Dudgeon in 1850, just ten years afterwards, to know the result, he learned that having become alive to the superior advantages of deep drainage, he (Mr. Dudgeon) with the concurrence of the landlord, had terminated his old leases several years before the date of their expiry, that he might have the inducement, which the beginning of a new lease would afford, to take up these very 30-inch drains and re-lay them four feet deep, which he had done. Here was a *material guarantee*, by one of the leading and most acute tenant farmers in Scotland, that deep draining on the stiff and cold subsoils of west Lothian, was the most effective and remunerative drainage. Having gone into Cheshire in 1841, and remained in that county for nearly seven years, he (Mr. Scott) there applied and carried out the system he had learned. He thus drained upwards of 1000 acres of land, superseding the "Fishbone" system, which was the only one then known and practised in the stiff clays in that county, the depth of such drains averaging only 20 inches. For the execution of these works he received a silver medal from the Manchester and Liverpool Agricultural Society in 1843, and again in 1844. The depth, as well as the inclination of this drainage, was ridiculed at the time by his local friends, and the landlord began to doubt the propriety of putting his money into such a *sinking fund*, and the tenants were unwilling to promise a per centage on the outlay. But what was now the result? Why, the landlord, agent, and tenants, were all superseding these drains, though many of them were three feet deep, with deeper ones still. the minimnm being 3 feet 6 inches. It was, therefore, with some degree of humility that he held this handsome medal for work now obsolete in principle and being superseded in practice, but he had rather blush for the past than hold out against reason and experience for the future. The rules of the same Society now say, "no drain to be less than 36 inches deep, but the Society recommend it still deeper." The drainage he had spoken of was executed on the estates of R. E. E. Warburton, Esq., and the Lord de Tabley. He now came to a happier epoch in his draining experience. In 1850, he went into the county of Wilts, as resident agent to Joseph Neeld, Esq., M.P., and being then fully convinced of the soundness of deep draining, and hoping that his Wiltshire friends might not know how much comparatively shallow draining he had been guilty of, he commenced by draining from 3½ to 5 feet deep, on all soils. Being a stage in advance of local practice, a war of words ensued with the tenants and neighbours, but he persevered for three years, and until nearly 2000 acres of land in Wilts and Somerset had been thoroughly drained in this way, being supported by the confidence of the proprietor throughout. At the end of the time mentioned, he began to perceive that he was being followed, but still at a respectful distance, by a good many of his early, but thinking and observing, opponents, and his mission ended by a handsome testimonial being presented to him as an acknowledgment that he had practically exemplified in that district a sound system of land drainage. Three more years had rolled by, and time had so far confirmed the result, that the ordinary farmers in that district were now deep drainers from experience, if not from principle. He thought that no stronger proof could be adduced than these examples, that 3 feet 6 inches was the minimum depth for drains on the stiffest soil, for permanency and effect; and though such drains might be put too far apart, as Mr. Mechi had recorded from his own experience, all drains sunk to a less depth *must* be too shallow to accomplish these two objects. As a further proof of this, he had evidence that the late Mr. Wm. Smith, of Braydon, near Swindon, in Wiltshire, executed some drainage on his own lands there in 1812, 4 feet deep and 20 feet apart, and though this was the most unporous soil and subsoil, he believed, in the three kingdoms, these drains were still running, and the land was effectually dry. He wished also to record here the result of an experiment which he made in 1851 with Fowler's Draining Plough, on 150 acres of the Braydon land, and which land Mr. Bravender, of Cirencester, had described in the *Journal of the Royal Agricultural Society*, as almost untractable. This drainage was done by contract, 3 feet 3 inches deep, and 16½ feet apart, the main drains being dug by hand and laid with 3 and 4-inch pipes, the outlets having grated pipes built in stone work, and the minor drains being left without pipes, except for about 12 feet in length from the main drains upwards. The economy of this work was great; sheep were now folded with advantage on the land, which was formerly unsafe for cattle, except for about three months in the year; the aquatic grasses had died out and better herbage had taken their place, and the annual value of about 100 acres of the grass land so drained was doubled. The average cost of this comparatively deep draining on Mr. Neeld's estates did not exceed that of the shallow and temporary operations previously in vogue in this district, namely, £4 an acre, on 1,800 acres of thorough drained land, labour being then at least 30 per cent. less than it is now. That the drainage was *thorough*, he had good reason to believe, from not having heard a single statement to the contrary from any of the thirty or forty occupying tenants over whose farms the drainage extended. An assistant of his (Mr. Seal) who superintended and measured the whole of this drainage, and now occupied one of the drained farms, said—"In no case have I found the deep drains fail on the most tenacious soils, and the same may be said of those on springy land." Mr. Seal had also given him some interesting facts relative to the supposed impervious soils of Strathfieldsaye, and which he (Mr. Scott) commended to the notice of Mr. Bullock Webster. He said—"My father, who was land steward on the estate when purchased for the Duke of Wellington, and for many years afterwards, drained the greater part of the park, upwards of 35 years

ago, at various depths, in some instances more than four feet deep, using tiles without soles, and covering them with heath—the result was satisfactory. A great part of the Speaker's land which adjoins Strathfieldsaye is also very stiff, but, notwithstanding, it will draw very well four feet deep." Mr. Easton, the present agent at Strathfieldsaye, confirmed this practice to him by stating—"On the stiff clay lands we put in the drains 3 feet deep, and 15 to 20 feet apart; on the more loamy soils 4 feet deep and 35 to 40 feet apart, and 25 years' experience proves to me that this answers well." If any one was at a loss to discern why 4 feet drains might be placed further apart than 3 feet drains, and still be more effective, he had only to consider that 4 feet drains removed the water 12 inches further from the surface, and left some 1,000 tons more dry soil per acre above the drains. The vacated water tubes in this large mass of soil then became air cells, and rainwater reservoirs in turn, and thus both of these elements were continually imparting to the drained soil ammonia and nitrogen, the most concentrated and essential food of plants, changing and ameliorating the most noxious subsoils to the depth of the drains. Four feet, then, appeared to him to be a settled standard of depth for minor drains on the great majority of soils in this country, and he thought this principle had been so well reasoned by scientific scholars and eminent engineers, and so carefully arrived at by practical men, that it would not now be easily disturbed. The principles then, which were so important, being now settled, mainly by the sound and deep reasoning of Mr. Parkes, and which Mr. Bailey Denton had lent no unimportant testimony to confirm, our next most important study should be the careful execution of the work. Relative to the advantage of draining, it was now too late in the day to speak—no one disputed it—it was an admitted fact, and to dwell upon its sanitary or agricultural benefits would be as unnecessary as to elaborate on the advantage of the sun's rays. The necessity of good pipes, though not yet alluded to in this discussion, was of vital importance. Whatever their shape, they must be well burned, and never less for any drains than 1½ inch in diameter, smooth inside, and well rolled at the ends to prevent their internal capacity being diminished by ragged edges. He had laid on the table a specimen of what a pipe ought to be, and also a new kind of junction pipe to connect the minor with the main drains. When a field had been drained, it should be immediately mapped for reference. He had always practised this, and would just give one illustration of its utility. Professor Simmonds, of the Royal Veterinary College, was lately advised by him to take a considerable farm in the neighbourhood of London, part of which he (Mr. Scott) had drained five or six years ago. The ditches round one of these drained fields had been neglected, and some of the drains were stopped up, but the professor did not know where to put his hand upon the evil, and wrote to him. He immediately obtained for him a copy of the drainage map, and he was thus enabled to dig down upon any drain or point of a drain he wished. Another and still more important point to be attended to when the drainage was finished, especially on large estates where it had been extensively carried out, was to appoint a steady and experienced hand as "drain-mouth inspector," who should be continually going about, seeing that all the out-falls were clear, and all the ditches kept below the level of the drain-mouths. He had always carried this out in his own practice, and found it a great satisfaction, and saving of money in repairs. To prevent the ingress of rabbits, rats, or other vermin, it was advisable always to adopt some kind of grating. His practice was simply to insert a three or four barred wire or wrought-iron grating between the third and fourth pipes; it was thus secure from injury, and always within the reach of examination. Thus far he had spoken from personal experience alone. If he now looked back to the previous night's discussion, he confessed he was at a loss to say what anyone coming to learn, and intending to drain, could gain by it. Some seemed to adopt geology as their guide, others abstract principles, while the aids of practice, eyesight, and common sense were very much overlooked. Now, he thought the latter qualifications had a good deal to do with the practical part of the question. Deep drainage was now the rule, and shallow the exception; but when we took that for granted, we must use the qualifications he had named, to modify it, and suit it to local peculiarities. As far as he could judge, Mr. Denton appeared to him to have adopted correct principles, and to be guided by sound personal discrimination. It was a curious coincidence that Mr. Denton's estimate, in 1855, of the sum required to drain all the wet land in Great Britain, £80,000,000, was the same as that calculated by him (Mr. Scott) in 1850, and recorded in a paper on Land Drainage, read before the Chippenham Farmers' Club, and published in the *Farmers' Magazine* for March, 1851. If both these estimates were correct, it showed that the rise in the value of drainage labour and material since 1850 was equivalent in amount to the whole expenditure in draining between that and the present time, probably £10,000,000. He demurred to Mr. Denton's apparent desire to draw the expenditure of all borrowed capital under the control of public drainage companies. The idea of giving drain-pipes to farm tenants, to bury as they liked, he had seen to be a most impolitic practice; but it would be equally impolitic to bring all the draining in this country into the hands of Act of Parliament companies. For his part, he did not see why they should continue to possess the monopoly they now did, and why entailed proprietors should not be at liberty to borrow on the most advantageous terms from anyone, whether a private individual or public body, to drain their lands, and give permanent or terminable charges on their estates, if the work were sanctioned and passed by the Inclosure Commissioners. In Ireland, the Board of Public Works was the great monopolist, preventing all private enterprise from going there, either individually or collectively, to facilitate the drainage of land by loans, and only itself advancing driblets to private owners, and these under the most embarrassing restrictions. One great good done in Ireland, however, was the opening up of the national arteries of the country. Here, we impeded them by thousands of petty corn mills, and there was no immediate sign of these impediments to land drainage being done away with, although the value of the extra produce that would thus be obtained from the lands at present injured by back water, or altogether excluded from tillage, would probably exceed the money value of such water-power. That Scotland was all but a completely-drained country, he had often thought, from observation, and we might infer as much from Mr. Denton's figures, for we found that £1,424,682 of a recent public loan had been expended there, with perhaps ten times that amount of private capital, in addition, on an area of 5,000,000 cultivated acres; while England had not expended even so much public money, and probably not more private capital, on an area six times greater. We thus saw the important work that was still before us in England, and had good reason to commend the practice of land drainage to the fostering attention of our great national association, the Royal Agricultural Society.

Mr. BULLOCK WEBSTER was sorry to disagree with so many authorities on the subject before the meeting; but he did differ in opinion materially as to the advantages of a uniform depth of 4 feet in strong clay subsoils not surcharged with under-water. It appeared from Mr. Denton's able paper, that more than two millions of money had been expended on drainage during the last few years, either government loans or borrowed from companies. Now what had we learned from that large expenditure? He quite agreed with Mr. Denton, that the results of the practice of the last few years had confirmed the principle, that depth might govern distance in soils of an uniformly open and porous nature; that in the denser clay soils this compensating principle was inadmissible, much clay land

having been drained imperfectly from having been drained two widely. In lands suffering from springs, or from pressure of water, where each drain should be designed for a special service, there was no dependence on one drain upon another, and, therefore, no rule of distance could apply. He also agreed with Mr. Denton in opinion as to the arrangement of the drains—that the result of the practice of the last few years had shown that the principle of parallel equi-distant uniformity was applicable only where there exist uniform texture of soil, and uniform inclination of surface; that it required modification directly the soil varied, and the surface became irregular, and that the desire for uniformity had led to a waste of money and imperfect work. He did not agree with Mr. Denton, when he said five four should be the minimum depth for all drains, and "that it is difficult to admit of a compromise of depth under any circumstances whatever." Experience had shown us that porous subsoils could be drained more effectually and economically with deep drains, and that springs should be cut off in the confined measures at various depths before they had injured the land below them; but he contended that soils resting on retentive clay subsoils not surcharged with under-water, (he was not speaking of subsoils with veins of gravel and sand containing water) should be drained not less than three feet deep, but that the depth must be regulated by the extent to which the clay cracks, and to where the water was checked by the retentive nature of the subsoil, for his opinion was, that these particular soils required drainage, because the water did not get into the subsoil, not because the subsoil was full of water. Our object, then, was to tempt the water through all the soil we could, and then get rid of it. Effectual three-feet drainage left no water below the drains; they were out of the way of all agricultural implements; roots of plants would as freely go into a four-feet drain as a three-feet one, if they had a tendency to stop up a drain. As to water running clearer out of four-feet drains than three, Professor Way's experiments had proved a much less depth of soil above the drains would extract all valuable matter from rain water or manure. He thought it would be found that the temperature would be quite as high on those lands drained three feet as four feet. He objected to the four-feet drains on these retentive clay subsoils, because you could not get your drains further apart, as Mr. Denton admitted. He objected to them because the extra foot, after three-feet, often costs nearly as much as the first three feet. He objected to them on account of the expenses of the out-falls in many cases, and the subsequent annual expense of keeping these outlets open. Let the roots of the crops be kept within the influence of the sun, in eighteen inches of well-manured soil, and he thought it would be found that the produce would be far more than if you tempted them into four-feet of clay subsoil, if you could do so. With regard to the deep drainage on the clay at the Duke of Wellington's estate, at Strathfieldsaye, it was tried and given up some years since. He was not aware of what was being done there now. He could show an estate in that neighbourhood where deep drains at wide intervals did so little good, that drains closer together and not so deep had since been put in. With regard to the Keythorpe system, he spent some days there the end of last October, and although there had been several days' rain, he never saw land in a more perfect state for all agricultural operations, and he did not think it fair of people to say anything against this drainage till they had seen it, and he believed Mr. Denton had not. We often heard of the retentive clay subsoils completely changing their character by the action of four-feet drainage; now he had frequently seen strong clays exposed a whole summer to the sun and rain in brick-yards, year after year, and yet they remained much the same. A soil might be altered by freeing it from water, and admitting air, but beyond the depth to which it was moved, no very great change would take place in the dense clay subsoil. He felt confident that many estates in this country would not cost half the money to drain, if all the main outlets were well opened, the springs cut off, and some of the upper lands laid dry, and then left for a year or two before the rest of the drainage was proceeded with.

Mr. G. Donaldson said, as he had for many years been engaged in works of land drainage, though not of late so employed, he still took much interest in the subject, which was one of the greatest importance, not merely to the agriculturist, but to the community at large. He regarded drainage as merely one step, and that a most important one, in the cultivation of the soil—for on a very large proportion of our lands good cultivation was quite impracticable until the soil was freed from superfluous moisture. It might be regretted that so many conflicting opinions had been upheld by those who had studied and practised draining, as it tended to throw doubt and difficulty in the way of those who wished to ascertain the best method; and possibly it might have led to the expenditure of money in inefficient work in some instances; but as this diversity of opinion and practice tended to excite attention and discussion, and to lead to a record of the effect of each method, it would eventually bring them to a knowledge of the best system for general adoption. Speaking of the results of draining, he would mention a piece of land in Clydesdale, which he drained in 1821-2. The land was previously so wet and boggy, that it was unfit for cultivation. It was drained on the Deanston system from three to five feet deep, and the third year after it was drained it produced a crop of wheat of six quarters to the acre, and 64lbs. weight per Winchester bushel, and had ever since been in profitable cultivation. And he might mention another instance—that of a field of nearly 300 acres on the granitic formation, also in Lanarkshire, which had never previously been cultivated, producing only a mixture of coarse grass and heath of little value; but after being thorough drained it was ploughed up, and produced a crop of oats which sold by public auction at £9 an acre, and the land was let for a second crop (let for one year only) at £11 per acre. Much had been said as to the proper depth of drains, or what was called deep and shallow draining. Now he believed that no general rule as to depth and distance apart would apply in all cases. What was deep for some lands would be shallow for others, and the most advantageous depth in each case must be decided according to circumstances. Some remarks had been made as to the depth to which the roots of various crops penetrated the soil, and the value of the crop no doubt greatly depended upon the depth of active soil available. Now it was well-known that the roots of plants penetrated the soil only so far as the atmosphere had prepared a way for them, but the atmosphere was inoperative in a soil surcharged with water, hence the utility of drainage. There were, however, two or three kinds of water to be dealt with in draining; first, the surface water from rainfall; then there was deep water which rose from below; and these must be differently dealt with. In most cases a few well-placed drains would suffice to dry many acres of under-water, while the removal of upper water required a greater number of drains of less depth. Again, of under water, some was more hurtful than others; for instance, in the South of Devon, where irrigation with spring water was successfully practised, there were to be found frequently in the same farm what were called cold and warm springs. The water from what was called the warm springs had a singular effect in fertilising the soil, while with the cold springs it was quite the reverse. Now, in draining the land of under water, wherever it was of the nature of those cold water springs, the deeper it was drained away the better, while in removing water of the quality of those so called warm springs to a great depth, was less necessary, as the land was not so benefited thereby. The various qualities of soils should be well understood, and also their capabilities of improvement, in order to their being economically dealt with in draining. The question of depth in drainage ought to be decided by the depth of active soil requisite for profitable cultivation. The best

test of efficient drainage was to be found in the temperature of the soil. The superior value of a deep, warm soil, was well-known, and the object of draining was to give depth and warmth to the soil. There were soils, some clay soils, for instance, in which no under water was found, and no great depth of drain was requisite for removing the surface water, but the drains should be deep enough to give such a depth of active soil for cultivation as might be desirable, even though a less depth of drain would carry off all the water. In many instances, great difficulties were experienced in obtaining outfalls, owing to water-rights on the course of rivers for mill-power, irrigation, &c. It was very desirable that the legislature should devise some means of obviating this, and it was equally so that records should be kept of the action of drainage, by a registry of the rainfall and the discharges from the outfalls; these records would become of great use as data for calculating what discharges ought to be provided for in future works.

Mr. R. B. GRANTHAM, C.E., wished to remark upon the latter portion of Mr. Bailey Denton's paper, in which he refered to the question of main outfalls for drainage. Some few years since the Earl of Carlisle had introduced a most valuable Bill into the House of Lords for this purpose, but nothing whatever had since been done towards that most important national object. The measure consisted in forming drainage districts, and appointing trustees to superintend them; and he considered that very great benefits would arise to the country if such a measure were adopted, so as to give power to lower bridges and culverts under public roads, straighten and deepen rivers and streams, and deal with the rights which would be effected by such operations over large tracts of country. But above all the removal of mills, dams, and other obstructions in rivers, which in many cases did incalculable injury, many times exceeding the value of the mills, by keeping up the levels of rivers, and rendering it totally impossible to drain the adjoining lands by pipe or any other kind of drainage. He wished to impress it upon those who are interested in the improvement of land by draining, that they should use their influence to procure from the legislature next Session, such a measure as would enable subsidiary drainage to be more effectually carried out; and he hoped that this Society would also use its influence to promote such an object. He was not advocating any particular plan, but thought that some such provisions as those contained in Lord Carlisle's Bill, under the control of the Inclosure Commissioners, would answer the purpose. He had for some time past paid much attention to some of the suggestions contained in Mr. Bazalgette's communication, and had prepared some tables for his own guidance, by which the sizes of main pipes to drain given areas could be determined, having especial reference to the discharge of water at certain inclinations, both of the minor pipes and the main pipes, and one with the other, as also the relative widths at which pipes should be laid apart, having reference also to the discharge of water at certain inclinations. He thought that it would be difficult to procure the return in the form which Mr. Bazalgette had pointed out, as many who are really interested in agricultural land drainage would not take so much trouble as it really was when properly undertaken.

Mr. R. F. DAVIS said the matter just stated was so important, that he could not refrain from making a few observations relative to it. If they were to go into the Midland districts, they would see great injury done from the damming up the water for mills. In the valley of the Nene they would not see less than a dozen such mills, which threw the water back upon the land. If the farmers of this country had not been indifferent with regard to undrained lands, they would not have seen their canny friends north of the Tweed obtaining so large a portion of the government loan as they had done. In draining lands some years ago, he found that 4 ft. 6 in. was the best depth for retentive clay soils. At first he stopped at 3 ft. 6 in., but afterwards found he had to deepen the drains to 4 ft. 6 in. Lincolnshire was an evidence of what might be done by district drainage. From a comparative marsh it now presented the finest arable land in the country. He was rather astonished to hear the remark that deep drainage was only necessary for a sandy soil, inasmuch as that would not hold the water. What they wanted to do was to draw off the cold water, which was unhealthy to the land and destroyed its powers of vegetation; and Mr. Parkes had quite settled that deep draining was the only effectual system. He considered it was the stiff clayey soil that required most draining, and from 4 ft. to 4 ft. 6 in. he thought was about a proper depth. A Lincolnshire farmer, ten years since, who paid £400 a year rent, told him he must give up the farm, or that if he went on without drainage he must take off £100 a year. He replied that he should increase the rent to £450 a year, and charge 6½ per cent. on the amount expended in draining. The year after the drainage he gave the farmer £25 to spend on oilcake, upon condition that he would spend £50 for a like purpose. This was on a farm of 175 acres, and last year he was told upwards of £250 was spent on oil cake, and £500 a year was readily paid for the farm. The cropping for ten years was, 3 crops of wheat, 1 of oats, 1 of barley, 1 of beans, 2 of seeds, 1 of rape, and 1 of turnips. This was working the land, and some persons maintained that there would be a falling off in its value, but where under the old four-crop system it would only produce from 4 to 4½ quarters per acre, it now produced 7 quarters. That was the result of drainage. It was too often found that for the drainage of land, the landlord found the tiles, leaving the farmers to put them in. That plan would never succeed—the work must be done by an engineer. The landlords ought also to see to the outlets being properly kept, for on half the estates in England where £1000 had been spent in draining, the expenditure had been useless, from the flow of the water having been left to John Smith or Joe Williams, who knew nothing about the subject. It was no use draining land without being provided with a good plan of the drainage. Drainage was frequently rendered of little avail, from the tiles being put in without any plan by which they could be traced. A tenant farmer once told him that some grass land did not produce so much after draining as before. Probably it did not in the first year. In the second, however, it was better, and in the third he saw lambs and ewes on it in February. In the fourth and fifth years it was still better, and in the sixth he did not believe it could be surpassed. No doubt it was originally a wet grass, which would not grow in a dry soil, and therefore the difference was not seen at first. The grass upon a dry soil might not appear so luxuriant, but the backs of the beasts would soon tell whether they had been fed on a wet or dry grass. He was anxious to impress upon both landlords and tenant farmers the advantage of drainage. Land should be drained in such a manner as not to put the tenants to any expense. Some landlords found tiles for drainage, but taxed the farmers to find the horses and carts for their conveyance. Why should they do so? By draining, the landlords were adding to the value of their own lands, and ought therefore to pay for it. In lands he was connected with the tenants paid 6½ per cent. on the outlay for drainage, and he found they were benefited to the extent of not less than 10 to 15 per cent., and in some instances even to the extent of 30 per cent. Once more he impressed upon them never to leave the drainage to be carried out by unskilled hands. A man should be no more his own drainer than his own doctor, or make his own will.

Mr. JOHN CLUTTON stated the result of his experience to be, that in the generality of soils, and in clays especially, drains should be laid at a depth of not less than four feet; that in the strong clays of the Wealden district, and in Dorset, &c., experience had proved that pipe drains four feet deep were, if not placed too far apart, more effective in draining land than any of a less depth. When he

(Mr. Clutton) began business 30 years since, he found his father making drains three feet deep, of broken stones and chalk; but the whole of the lands so drained had been for some years, re-laid with pipes, at a depth of not less than four feet. He (Mr. Clutton) stated he was not aware of a single instance of deep drains having been replaced by shallow ones, but he knew of numerous cases of shallow drains having been replaced by deep ones. It was remarkable, he thought, that there was not an advocate of the shallow system of draining in the room, with the exception of Mr. Webster, whose arguments tended to show that the strong clays were pulverised and ameliorated to the depth of the three-feet drains, but it did not appear to strike him that if the drains were laid at four feet deep, the clays would be converted to that depth into active soil, adapted to the growth of plants. The effect of deep draining on clay soils was not only to alter their texture but also to change their colour,—a yellow clay becoming, in a few years, a good hazel loam. These changes were not effected at once, but were brought about gradually, by the operation of worms, insects, &c., working together to the water level, whereby the atmosphere was more readily admitted with the rain-fall water, which imparted to the soil, to the increased depth, all the advantages so well pointed out by Professor Way, in his recent lectures to the Royal Agricultural Society. He (Mr. Clutton) had had considerable quantities of three-feet drains taken up as quite ineffectual to dry the land, and the land re-drained at depths of not less than four feet, by which it had been effectually dried. He gave an instance of a dairy farm in Dorsetshire, upon a very stiff blue clay, drained four feet deep, where the stock had been increased at least 25 per cent., and a flock of sheep kept where none could live before; while upon an adjoining farm, on which three-feet drains had been laid, the land was unimproved, and remained nearly as wet as before the drainage. He could not agree with Mr. Denton in recommending that the number of acres draining to one outlet should never be more than twenty, as he had found by experience, that the largest possible amount of interior drainage should be carried into sufficiently large main drains; indeed, as a question of ultimate advantage and economy, he would, if it were possible, take the whole drainage of a farm into one outlet, as few tenants were found who would pay the necessary attention to the mouths of drains; and as the number of mouths was increased, so the danger to drainage, through oversight and neglect, was increased. This last point of outfall brought him to the consideration of the arterial drainage of England, and to the very insufficient power at present existing to enable owners to obtain increased depths for the outfall of drains and watercourses through the lands of adjoining proprietors. The legislature, from a desire to protect private rights, had not hitherto granted sufficient enabling or compulsory powers for the improvement of the arterial drainage of England; and without controlling and sufficiently compulsory powers many districts in this country could not be beneficially cultivated. The time, he contended, had now arrived when authority should be given to commissioners, or other competent parties, to carry out the works necessary for the proper drainage of the districts requiring it; and he urged the impolicy of landlords entrusting to tenants and others, not qualified by education and experience, the execution of drainage works, and showed the danger of supplying tenants with tiles, and allowing them to put them in, without the supervision necessary to insure the proper formation of the drains. Engineers and others who devoted their time and attention to the subject should be employed to lay out the drainage of land, and see to the proper execution of the works. One-half of the drainage hitherto constructed was inoperative, because the necessary — and he might say the essential — knowledge and experience of scientific draining engineers and surveyors had not been called in to aid the local—and it might be he practical—knowledge of the tenant or bailiff, to whom the works had in too many instances been intrusted. Without intending any reflection upon tenants generally, it must be admitted that they did not appreciate the difficulties attending the proper laying out, and the execution of a comprehensive scheme of thorough drainage. The necessity for a correct plan of drainage, executed on a comprehensive scale, could not be too strongly urged. Without this, drainage works, however, well executed, would become deranged—if not destroyed—in a few years, as the direction and outfalls were forgotten; and he would again urge that where the outfalls were numerous, they were the more likely to be forgotten or neglected than if the drainage of large tracts were concentrated and carried into mains of large dimensions, whose magnitude would command attention.

Mr. HEWITT DAVIS said his experience in draining had been so decidedly in favour of what was termed deep draining, that he had long ceased to drain shallower in any soils than four feet, whenever a fall of that depth could be gained; and he gave four feet as a minimum depth, because he was convinced occasionally that there were soils and conditions where it was advisable to go much deeper. The wetness of the surface of land appeared to him to arise from two different conditions of the soil, and that these called for different systems of draining, both as regarded depth and distance. He considered most soils, and more particularly what were called "strong," were made wet by the surface water sinking only a short distance and accumulating in the pores and fissures of the subsoil until it reached the surface, and it was with this standing water that the drainer usually had to operate, and he gave four feet as the minimum depth of the drains in these soils, because he had always found that the cracks and fissures formed by the drought and changes of temperature, on the strongest clay, and which made these soils permeable, extended below this depth, and the water from the surface might be made to reach the drains at this distance. He did not advise going deeper when the object was merely to take off the surface water, because the difficulty and expense then too rapidly advanced to admit of doing so with advantage. As these descriptions of soils were made wet by water that soaked perpendicularly, and rested in the soil, and called for draining solely to rid them of water that reached them from the surface, they were only to be laid dry by parallel drains down the fall, at widths regulated by the depth of the drains and the facilities that the openness of the soil offered for the water to draw into the drains. The other description of draining solely applied to land that was made wet by land-springs, or water which reached it from a distance, as well as from its own surface, and was brought to the surface by the cropping out of the impervious strata on which it lay. It was to this description of land that Elkington's system of draining by spring-tapping was applied with so much success a hundred years ago as to gain him a parliamentary grant of £5000. He found that by cutting up the hill and across the clay into the watery bed upon it, that he frequently succeeded, by means of a single deep drain, in laying a considerable distance dry; but we must not forget that his success lay in dealing with land made wet by water brought to it and oozing on to its surface, and in intercepting it before it came to the surface. Had he (Mr. Davis) heard Lord Berners's description of his soil, and its watery fissures, previous to Mr. Trimmer's account of it, he should have understood that he had dealt with land springs or water brought from a distance, and that he had succeeded in laying it dry upon Elkington's system of cutting through the side of the strata that basined it in; but this system of draining could be applied only to particular soils and circumstances, and the greater advantages from parallel draining were found to still more narrow the field for its adoption. With respect to Mr. Bullock Webster's remarks, with reference to 4 feet and shallower drains, and his objections to the rule "that

depth should govern the distance between the drains," or, in other words, "that increasing the depth in clay to 4 feet extended the distance they drew," he need say little, for every farmer's experience in ditching and water furrowing was against him; and Lord Lonsdale had well exemplified the effect of depth in drying the land, by saying that he early learnt the greater benefit of depth in his experience in road making, from observing the assistance that deep draining the road-sides gave in laying the ground between the drains solid, and he (Mr. Davis) appealed to Mr. Denton to say whether or not he did not find that the deeper the drains on all soils the wider they drew. He (Mr. Davis) began draining 25 years ago, by laying bushes two feet deep, and a rod apart, but he soon found that by going deeper the drains drew farther and laid the land drier; and for the last 20 years he had never drained less than four-feet deep.

Mr. J. BAILEY DENTON was glad of the opportunity of saying a few words in reply, and they would be addressed rather to what took place on the first evening's discussion than to that which had occurred that night, to which he had very little objection to raise, for every opinion expressed seemed but to confirm the principle of depth for which he contended in his opening paper. They certainly went very far from the objects of the discussion, when they listened so long to what was said with regard to the Keythorpe system; and he said this because so little was understood in what was stated. Without detaining the meeting on the Keythorpe question, which he hoped to say a few words on presently, he would refer at once to the remarks made by the various speakers at the last meeting. Objections were made to his having omitted certain topics. He believed Mr. Hewitt Davis went so far as to say that he should have gone more at length into the theory of draining. Another gentleman said he ought to have discussed more in detail the practice; but he thought the objections made were undeserved, for it was not from underrating the importance of the omitted topics that he left them to be spoken of by other persons, but because he had not time to enter upon them. He thought, as Mr. Scott stated, that we ought, after ten or fifteen years' experience, to have come to some conclusion upon principles which should govern our practice. We ought to be in a condition to confirm those views that practice had shown to be sound, and to reject others, without discussing the first principles of drainage at this period in the progress of the art. On the last occasion there seemed to be altogether wanting a right knowledge and appreciation of the several elements with which we were dealing in draining. The various speakers confined their observations to the one object of discharging injurious water; they disregarded the benefit and influence of air on the soil. Others disregarded the force of gravity in carrying water, which is 815 times heavier than air, through a soil rendered permeable to both by draining to an approximate depth of the drains. Mr. Clutton had shown that evening the effect of air and water admitted by drainage into the subsoil. Lord Berners, on the contrary, stated the other evening that water would not percolate through clay. His lordship stated this without giving any proof of the fact, and left the meeting without explaining where and how he had conducted the experiment upon which the assertion was based. It was a fact, however, that some of the lias clay (to which his lordship particularly alluded) had been effectively drained at a uniform depth of four feet and upwards; and he (Mr. Denton) was prepared to show that such clays were as homogeneous in character as any clays in the country. Lord Berners spoke of the cheapness of his drainage, and to this point he (Mr. Denton) would now refer. He did not propose to touch at all the question as to whether the land at Keythorpe was effectually drained, as far as the mere removal of water went. He did not presume to deny that, for water would run quickly off land with a rapid slope, even with surface gutters, but this he did not regard as answering all the objects of draining. Lord Berners had probably got rid of the water too quickly by his shallow drains, and had lost all the benefit to be derived from air and water passing through an adequate depth of soil. With respect to cost, some evidence was afforded by the plan which Lord Berners laid before a committee of the House of Lords last Session, and which had been appended to the evidence taken before that committee, as a specimen of the description of plan which should accompany all works of drainage, and for that purpose it was unexceptionable. But in the margin his lordship stated that the "cost of draining" 46 acres of land was £79 19s. 7½d.; and this was put in, indirectly, as evidence of the cheapness of the Keythorpe system. Now he (Mr. Denton) found that at least one-tenth of the land was drained only eighteen inches deep, and when this was objected to the other evening it was stated that the drains were laid in the furrows, and that a sufficient depth was obtained by throwing the ridges into those furrows, and thus gaining a uniform surface. This might be very good as an act of after-treatment of any drained land, but if it was positively necessary, to overcome the evil of draining 18 inches deep, the cost of doing it should be added to the cost of draining; but this item was omitted. Then, again, seventy-six loads of stone were charged for at a cost of £3 10s.,—he presumed as the cost of material.

Mr. TRIMMER—That is collecting the stones out of the drain, for which the men were paid extra.

Mr. DENTON—That might be so, but where was the material used for the drains, if this 70s. did not represent its cost. If stones were used and a shilling represented the cost of collecting, where was the cost of breaking them to the proper size? Where was the cost of haulage? Where was the cost of superintendence? All these were items which must be paid for, and which were entirely omitted, so that in fact it was patent on the face of this Parliamentary plan, that the cost of £79 19s. 7½d. represented simply the operation of cutting and the mere collection of stones.

Mr. TRIMMER—The men were paid a certain price for cutting the drains, and extra for sorting the stones.

Mr. DENTON—Just so. He had said enough to draw attention to this paper, which, when regard was had to the character of the work, he pledged himself could not fail to disabuse the public mind on the score of cheapness. For one moment let us go into the question of the subterranean furrows. They were described by Mr. Trimmer as the minor drains of his system, by which water would flow down into certain transverse pipe drains; but, as he had just said, Lord Berners excused the 18-inch drains, on the ground that they were laid in the surface furrows. How were we to reconcile these two facts? Was it possible, by some strange coincidence, that the surface furrows adopted by his lordship as the course of his drains, should exactly accord with the drains prescribed by Mr. Trimmer as necessary to draw the water out of the subterranean furrows, or was it not more likely that the surface furrows would agree in their course with the subterranean furrows. An answer was wanted to these questions. Unfortunately, the public mind had been distracted from the main question of permanent drainage—its results and progress—by the proposition of Lord Berners setting forth the cheapness of his system, and the explanation of Mr. Trimmer giving a scientific bearing to it. He said distracted, because we had not got at the real cost nor all the facts of the case, and which we must have before the Keythorpe system could be generally entertained. Mr. Bullock Webster had alluded to his having stated that it required the drains in heavy clay lands to be placed as near to each other whether they were deep or shallow. He had stated that opinion rather more positively perhaps than he ought, but at the same time he must repeat, that his experience led him to the conviction, that in decided clay soils—homogeneous clay soils—the theory applicable to the more porous lands, that was that depth might govern distance, did not hold good. He could not but repea

also, that with regard to the prevailing mode of carrying out works of drainage, we adhered much too closely to the parallelism of drains, and that, undoubtedly, different descriptions of soil had been drained upon too uniform a system. There was another point upon which he thought we were much in error. He referred to the disregard that was manifested to the influence of hydrostatic pressure. We did not sufficiently attend to the fact, that water taken in at a higher level finds its way out through porous strata at a lower level, and with such force as to overcome the gravitation due to drains which would otherwise be effectual. He was desirous to make himself understood upon this point, because he considered that it was an essential element in securing successful drainage. As pressure of water was always due to height, and not to quantity, we ought to have regard to the source from which the water, finding its way out at the hill sides, flowed. Any person who had but a faint knowledge of geology would be able to follow his remarks. We might frequently observe that water falling on the tops of the hills, found its way through the soil, and burst out at the sides, often drowning the lowest lands. Now, he knew from frequent intercourse with landowners and occupiers, that the lands first selected by them to be drained were those which exhibited the greatest amount of wetness, and he had known much discontent follow efforts of draining, because the hill-side lands occasionally showed wetness, and the lowest lands were frequently but slightly benefited. The cause was manifest. The water which had travelled through the porous soil to its lowest vent rose to the surface by those pores and interstices of the soil which were nearest and freest, to the disregard of any drains at a greater distance, and thus the objectionable wet spots in the hill-side lands occasionally occuring in drained land. The lowest lands were even more affected still, for they not only had their own quantum of water to bear, but they received the surplusage of the hills, and until these hills were drained no number of drains, however closely placed, would effectually drain the lowest lands. The remedy was in such a combined system of operations — he did not mean uniform parallel drainage—that the pressure from above should be removed at the same time that the lower lands were being drained. With regard to outfalls, which was the last subject to which he should allude, he was happy to say that he believed there was some prospect of an Outfall Bill being introduced into Parliament during the ensuing session. We were, in truth, approaching the time when the matter must receive attention, for although the quantity of land drained was small in comparison to that which remained to be drained, the water which was discharged by the drainage already effected found its way so rapidly to the outfalls, that the consequences were becoming more and more injurious every day. The millers were now suffering from two causes. At times of excess after a considerable fall of rain, and when the miller was injuriously overloaded, the excess was increased by the rapidity with which the under drains discharged themselves, and as the quantity of water thus discharged must necessarily lessen the subsequent supply, the period of drought was advanced in a corresponding degree. As the millers already saw this, and were anticipating increasing losses, they would join in finding a substitute for water-power upon fair terms. Although steps should be taken before the evils accumulated too much, it was obvious that every year's progress would make the miller less anxious to retain the water landowners were gradually riding themselves of; and thus we might hope that the millers would think it their true policy to abstain from opposing the passing of a proper Outfall Bill.

The Chairman, in summing up the remarks, stated that although practically he could not lay claim to that thorough knowledge of the important subject under discussion evinced by those gentlemen who had spoken on this and the former meeting, yet theoretically he had on frequent occasions been obliged to investigate closely the principles and practice of drainage, especially some years ago, as one of the editors of the *Farmers' Encyclopædia*, and subsequently in different agricultural periodicals with which he was connected. The great importance of the subject, whether in a national or individual point of view, could scarcely be overrated, and the deep interest taken in thoroughly ventilating the question was well evidenced by the large attendance of agriculturists when Mr. Denton's paper was read. Although they were less fortunate in their audience on this evening, owing to the farmers and others attending the Smithfield Cattle Show having returned to their several districts, yet it was clear that there were many who took a deep interest in listening to the views of those competent to give information, or they would not have quitted their comfortable firesides on a severe winter evening like this, to attend a discussion on drainage. So many vital interests were identified with the correct practice and principles of drainage, and its general adoption in an island like this was so necessary, since much of the land without drainage would be perfectly worthless, that the more generally the subject was discussed the better. It was quite possible by due attention to the nature of the soil, by a proper application of manures, and by a judicious course of cropping, to render ourselves perfectly independent of foreign grain supplies, but this was of course a matter of expense, as to the cost at which food could be raised for our population. It had, however, been shown that drainage, properly and systematically conducted, although seemingly alarmingly expensive at first, was in its ultimate results highly remunerative for the outlay. If the exceptional instance mentioned by one of the speakers, of seven quarters to the acre, could be made the average produce, instead of three or four quarters, as at present, our wheat crop would thus be doubled, and we should have enough and to spare, without drawing upon America or the Black Sea provinces. There were other considerations connected with drainage, besides increasing the fertility of the soil, and these were, improving the health of localities by reclaiming swamps, diverting the superabundant waters into proper channels for irrigation, for the supply of mill-streams, and thus furnishing adequate water power for keeping up canal navigation, river-channels, springs, and reservoirs, for the supply of towns. Much valuable information, from many practical and experienced men had been elicited by means of Mr. Denton's paper, and the weight of evidence certainly corroborated the value and utility of deep drains as enforced by him. Several very useful suggestions had also been thrown out which merited attention; especially the more general adoption of plans of the drains on an estate, and the entrusting of the works only to skilled practical engineers, so as to leave the farmer at liberty to attend to his husbandry pursuits, without meddling with the planning or management of the drainage. Not the least important of the recommendations in the communications read that evening was that made by Mr. Bazalgette, of carefully-kept registers of the rainfall in different localities. Without some general knowledge of the quantity of water received on the soil, the mean annual and monthly averages, and the number of days on which rain fell, little could be done to keep the land clear of water, or to regulate the drains and the outfall. Rain gauges were much too seldom kept in the agricultural districts. This was a matter which he (the chairman) had recently pressed upon public attention in a paper which he read at the last meeting of the British Association, "On the Rainfall of various Countries," wherein he stated, "We are as yet sadly deficient in accumulated facts from various districts which shall guide us to a knowledge of the mean average fall of rain in certain periods, the proportionate evaporation, and the alternation of wet and dry seasons. If we could obtain, from a long series of observations in various localities, any data to guide us in arriving at approximative estimates of the fall of rain, these would prove of great interest to the agricul-

turist, the engineer, and the physician." Although we were considering this matter specially as it regarded the improvement of the lands of our own island, there was no doubt the benefits would ultimately extend further. Many continental countries took their tone from us, and watched with interest our agricultural improvements, availing themselves of those which they found applicable to their special circumstances and localities. So also with our colonies. There were many low lying districts in Demerara, in India, and other quarters, where drainage on scientific principles might be beneficially carried out for the advantageous cultivation of staple crops, and the improvement of the health of the district. There was another portion of the subject which had been touched upon requiring early attention in the legislature, namely, the necessity of some enactment for enforcing uniformity of action—for harmonizing and connecting the drainage plans carried out, so as to prevent clashing, and for dealing with many private rights affected by the adoption of an effective and general system of drainage. In the name of the Society he had now to present their cordial thanks to Mr. Denton, a gentleman whom personally he had long known, and whose scientific researches and practical operations he highly appreciated, for the elaborate and very valuable paper with which he had favoured the members.

The Secretary announced that there would be an *Extra*-Ordinary Meeting on the evening of Wednesday, January the 9th, when the second part of Mr. J. Kenyon Blackwell's paper, on "The Present Position of the Iron Industry of Great Britain, with reference to that of other Countries," will be read.

Particulars of the arrangements already made for the following meetings, will be found in the Society's advertisement on the front page.

ON MACHINES AND PROCESSES FOR PREPARING FIBRES.

By P. L. Simmonds.

As the fibres of Indian plants are now attracting considerable attention among European manufacturers, it may be of some use to publish the results of experiments that have been tried to prepare them for the English market, and to turn them to practical account in various quarters. I therefore avail myself of the practical instructions published for local use by Dr. Hunter, of Madras, and various information furnished me from time to time by my colonial correspondents in the West Indies, at Singapore, in New Zealand, and Central America.

The demand for fibrous substances as substitutes for flax, hemp, silk, cotton, and hair, is becoming so great, that the market cannot be supplied with a sufficiency of these raw materials to keep our large manufactories in full operation, and India and the Colonies are now looked to as the quarters whence these supplies must be furnished.

Flax, hemp, and cotton are the substances most urgently called for; and as the two former are wasted in large quantities in many parts of India, and are hardly ever prepared with sufficient care to make them profitable articles of export, a description of the simplest and most economical methods of cleaning them may prove of interest to the public; and as numerous requests have been made for detailed accounts of these experiments, it may be as well to give them extended publicity.

The usual process followed in India, for preparing the fibres of succulent fleshy plants, consists in cutting the plants, when in full vigour, and burying them in wet sand on the banks of a running stream, or in mud at the edge of a tank, and leaving them there to soak and rot for one, two, or three weeks, according to the temperature of the weather. The plant is then taken out and spread in the sun to dry, after which it is stacked, or put up in heaps, and covered with a matting of dry leaves to shelter it from wind or rain. It is afterwards beat with heavy sticks upon the dry hard ground, and well rubbed between the hands, to separate chaff and dust. Another method is to take the soaked plant in bundles and beat out the pulp and impurities on a flat stone, at the edge of the tank or river, in the same way as the washerman washes clothes.

The fibres of the marool, or *Sanseviera Zeylanica*, are prepared by scraping and washing in fresh water soon after the plant is cut. The fibres of the Yercum, or *Calotropis gigantea*, are separated by exposing to the sun, for three days, the fresh cut stalks of the plant stripped of the leaves. The bark is then peeled off, and the fibres are picked out with the finger and thumb. The two last processes yield fibres of good quality, but in too small quantity to prove remunerative, except as an employment for children. The system of cleaning fibres by rotting is not suited to warm climates, as putrefaction sets in almost as soon as fermentation; and while one part of a heap of leaves or stalks is beginning to ferment, other parts are brown and stained from putridity, while the central parts remain fresh and unaltered. To preserve the colour and strength of fibres, all that is necessary is to separate the pulp, bark, or wood, as soon as possible, and by the least complicated process. The pulp, or juices of plants usually contain mucilage, starch, or gum, which begin to ferment within 24 hours after the plant is cut; and if they be left in water during warm weather, fermentation is completed within two or three days. In cold climates it takes from three to four weeks to run its course. The result of fermentation being completed, is that the sap becomes acid and destroys the strength of the fibre. This is followed by putrefaction which stains the fibre, and makes it brownish, and brittle, like chaff.

If the plant be exposed to the sun for a day or two after being cut, the sap dries, and the colouring matter stains the fibre, which cannot then be easily separated from the bark, spiral cells, or woody fibre. In some plants this discoloration is green, in others brownish, or dusky yellow, which cannot be removed by bleaching, as it is a species of natural tanning which occurs in the plant. Such fibres always remain harsh, stiff, and woody, with a tendency to snap on a sudden strain. The plantain fibre is the most liable to this defect, from the sap containing a good deal of tannin, which can only be removed by quickly expressing the juice, and only cutting as much of the plant as can be cleaned in one day.

The general rules for cleaning the fibres of pulpy plants are, first to bruise or crush the plant, keeping the juice for a coarse kind of vinegar, required in another process. The common native sugar-cane mill, with two perpendicular rollers, a long lever handle, and a channel to convey the juice into some convenient vessel, answers this purpose very well; the cost of such a mill is about ten rupees (£1). Those who cannot afford to purchase or erect one, but who can command plenty of Cooly labour, will require to provide a few long planks and heavy wooden mallets, to beat the plant till all the pulp is loosened.

When it is in a pulpy mass, it must be taken at both ends, and twisted opposite ways to squeeze out the sap. It is then to be well washed in plenty of water, untwisted and scraped, in small handfuls at a time, on the board, with an old blunt table-knife, or a long piece of hoop-iron fastened into a straight handle. When all impurities are removed, the fibres may be soaked for an hour or two in clean water, and then hung up in the shade to dry. Exposure to the sun at first is apt to discolour them. By this simple process, fibres of great strength, of a silky appearance, and of a good colour, can readily be prepared. The scrapings must be well washed and set aside in the shade to dry as tow for packing, or as material for making paper.

The Indian plants, to the cleaning of which this process is applicable, are those of a fleshy or pulpy nature, as the aloe, agave, sanseviera, and plantain genera, of which there are so many species.

On the Cleaning of Plants having Bark and Woody Fibres.

Many of the Indian cordage plants are of this kind; and the native process of cleaning them is very similar to that followed in cleaning fleshy and pulpy plants, viz., by burying in sand or mud at the edge of a tank, or in a river, and leaving them to rot. There is this difference, however, that the plants are steeped longer, and are never exposed to the sun to dry, or stacked and covered with matting, to be cleaned by dry beating. If this were done, the woody fibre would get hard and brittle, and would again adhere to the other fibre, which, being partially rotten, would break in the cleaning. To obviate this, the rotted plant is taken up in large handfuls, and beaten on flat stones, first at on end, and then at the other, in the same way as clothes are washed by the washerman. They are next well rubbed and washed, to separate the impurities, and are spread out on the ground to dry. We can hardly wonder that most of the string and rope made from fibres, prepared in this rude coarse way, should be dark in colour, possessed of no strength, and of little value. As a general rule, every day's steeping of a fibre takes from its strength, and imparts more or less colour. To obviate this, woody plants should be first well beaten with a mallet; then the bark should be separated from the stalk, for it is on the inner part of the bark that the fibres for cordage usually occur. When the bark is brought to a pulpy state, it must be well washed in clean water, to remove as much of the sap as possible, for this is the destructive agent, which soon causes putrefaction. The old mode of steeping, or rotting flax plants, is quite abandoned in many districts, as the water was found to be poisonous to cattle and fish, and the neighbourhood where it was carried on became feverish. The same remark has been made in India; and there are many districts where flax is cultivated on account of the linseed, but the plant is burnt and the fibre washed, lest cattle should be poisoned by eating it. In Flanders, where the greatest care is bestowed on the growth of flax, the preparatory crops are barley and rye, with turnips after them, the same year. It is grown the third year of a seven course rotation, or the fifth year of a ten course rotation. It is considered an exhausting crop, and the land is richly manured, and dressed with liquid manure; the seed is then sown abundantly in the proportion of 160lbs. to the acre; a slight harrowing and the passing of a light roller over the ground ensuring quick germination. If the quality of the fibre be the chief object, the seed is sown thickly; the plants come up in a crowded manner, and are tall and of delicate growth. If the seed be the chief object, then wide sowing and exposure to the sun is the best; the stalks becoming strong and branched with coarse fibre. The weeding of the flax forms a considerable item in the expense of its cultivation. This is performed when the plant is a few inches high; it is done by hoeing, or by women and children, who with coarse cloths around their knees, creep along on all fours, which injures the young plants less than walking upon them. The weeders also take care to face the wind, that the tender flax, bent down by their weight may be assisted in rising again. When weeding is too long delayed, the plants are bruised and injured, and cannot recover their erect position. Some tall and slender varieties are supported by stakes, lines, and cords, about one foot eight inches from the ground; or ropes are tied to stakes lengthways and crossways, so as to form a network all over the field. The time of pulling the crop depends upon the season, and the intention of the grower. If fine fibre be his object, he pulls the flax rather green; but if the quality of the seed be considered, a longer time is given before pulling. The latter object is generally attained when two-thirds of the stalk have turned yellow, and when the seeds have changed from their fluid state; for they ripen sufficiently after the flax is pulled, if not separated from the stalk. Taking up the crop in a wet state is avoided if possible. The pulling is carefully done by small handfuls at a time, which are laid regularly across each other to dry, and are afterwards collected in larger bundles, the root ends on the ground, and the seed ends tied lightly together, as sheaves of grain in the harvest-field. The practice of cultivators differs very much as to the after-processes. Some disregard the seed and commence steeping the flax at once; some carry it as soon as it is dry under a shed, and take off the capsules by a process called rippling; others house the flax as soon as it is dry, allowing the seed to remain on, and deferring the processes of rippling and steeping till the following season.

Memorandum Relative to the Plantain Fibre.

Several modes have been recommended for the preparation of this fibre.

First—Beating, washing, and drying.

Second—Simply cutting and drying.

Third—Scraping.

If we look at the structure of the plant itself, we shall be able to form an estimate of these processes.

The plant is composed of at least two very visible rows of cells, an inner and an outer, along its whole extent upwards and downwards, and through every layer, there being several layers.

The cells are formed of fibre for "uprights," and "sills," and "plates," and tissue as it were for "plastering;" the former useful for ropes, drills, etc., the latter for paper.

Of the processes above, the last is the only one that produces fibre in its pure state; but whether we scrape from the inner or outer surface, we must lose all the tissue, and probably more than half the fibre.

The first process will produce the material of the plantain stalk in a fit state for shipment with partially clear fibre, but nearly all the tissue will be lost. The washing also should be simple rinsing, as the allowing the tissue to remain in water tends to discolour it greatly.

The second process I imagine would be very slow, in consequence of the abundant water of the stalks. I apprehend also the discoloration which would ensue from this process, would render the material all but unfit for market, except at a very low rate.

It seems desirable that three or four objects should be kept in view in any process.

First—Saving of the tissue for paper.

Second—Preserving that tissue of an agreeable appearance.

Third—Ultimate freeing the fibre from the tissue.

Fourth—Preserving all the fibre.

And with relation to these, the process and mechanical arrangement are to be considered.

By no process of the hand can clean fibre be profitably procured. For this, resort must be had to machinery.

The material for fibre—fibrous material, as we shall term it—that is to say, the stalk after it has undergone process without separation of the tissue or pulp, may be prepared either by hand or machine—the latter being of course the most economical.

Squeezing, rinsing, partial separation, or "teazing" with the hand after being hung up on rails of bamboo, or other cheap article, and rapid drying, may be recommended as a simple and efficacious process for obtaining the fibrous material in a favourable state, and with the several objects referred to in view.

Machinery for performing this, and effecting the final separation of the fibre from the pulp or tissue must be a desideratum. In the absence of such machinery parties can hope to prepare only advantageously the fibrous material, and that by hand.

It has been supposed that boiling of the material would render the separation of the fibre at a future time more easy—but this seems unnecessary. Simple saturation in water for some few hours renders it fit for further process.

At a recent meeting of the Society of Arts, Jamaica, Mr. G. W. W. Clarke exhibited a machine he had constructed

for preparing fibre, with the improvements made in it since a previous exhibition.

The machine was worked in the presence of the meeting, and produced excellent specimens of fibres from the Spanish and Jamaica dagger plants.

Mr. Brown, the secretary of the Society of Industry, at Hanover, Jamaica, has also invented a machine for procuring the fibre from the plantain stalks. It is a large cylinder, revolving on an axis under large knives, so placed as to clean the fibre completely by scraping.

I have had repeated inquiries respecting the cheap machine of Mr. Burke, to which I made allusion in my lecture last year. In reply to these inquiries from Ceylon, from the Cape, from Algeria, and other quarters, I may give the following information:—

(*Extract of a Letter from Mr. Burke.*)

"I have been delayed somewhat in getting the machine[8] out, but very soon shall be able to supply you.

"As the evidence of the importance and value of the invention has accumulated, so it has behoved me to be more careful, that I may not lose at least a portion of the profit by bringing it out in a state that might enable some other to top it by an improvement. I have therefore been closely engaged with the machinist who is just fit for the work, in a course of experiments, trying different adjustments, &c., &c., having had over large supplies of stems, aloe leaves, &c., per Royal Mail steamer. The results are very satisfactory, showing I was right at first, and giving us confidence that it will be so perfect as not to be capable of any improvement not covered by my patent. I have also fitted a feeding apparatus to it, which adds to its value, and am engaged completing a small machine to use up the inner part of the stem—the top of the plant where the leaves branch out, and the leaf stalks, all full of fibre fit for paper; for this article I can now make large contracts. I am also preparing a press to put up fibre and paper stuff in proper bales for shipment, and suitable apparatus to work several machines by animal power, where desired. I have also arranged for the extensive manufacture of the machines, so as to meet all demands when we do start, so that the means to prepare all the material ready for shipment in the tropics shall be obtainable when desired.

"The matter has assumed so much importance as to justify and call for these arrangements. That there is a market at good prices for our W. I. fibre is now clear beyond a doubt; the evidence has already accumulated to make it certain, and in due time it will be published."

A late Antigua paper also states:—

"We understand that the machine invented by the Honourable Francis Burke, of Montserrat, for cleaning and preparing the plantain, aloe, and snake-grass fibres for the hands of the manufacturer, has in every way proved highly successful, and that he has greatly improved it in England. The invention was subjected to the most rigid experimental tests by practical and scientific men who have expressed their unqualified approval of the certainty and facility with which the machine operates; and the perfect manner in which it cleans the fibre without injuring, or in any way impairing its strength. The improvements effected diminish the amount of manual labour, which was even in the first instance very inconsiderable, and renders it capable of preparing any quantity of fibre with very little manual labour. It is said to be fully qualified to meet the wants of the colonies. Several machines are on their way to Montserrat, and others will follow to Demerara, where a large premium for an improved invention of the kind has been offered by the legislature. It is probable one will be set to work in Barbuda, for preparing for shipment the aloe fibre in that island. As Mr. Burke is associated with several large capitalists in England who take an interest in the West Indies, there is every chance of the invention having a fair trial and being brought into active operation in all the colonies where native fibre is to be found in any considerable quantity. We learn Mr. Burke may shortly be expected in Antigua."

I understand, also, that Mr. Sharp, who has certainly applied himself most indefatigably to the subject for the last year or two, has made some extensive additional arrangements in the machinery patented by him last year. These improvements are stated to be so important and effective, that each machine, upon the new principle, will produce a *minimum* quantity of 10 or 12 cwt. of fibre a-day, the fibre of a large plantain being separated in a minute or a minute and a-quarter, throughout the day; and I am aware he has offered to prove that a full-sized plantain-tree, of 10 or 12 feet in height and 6 or 8 inches in diameter, shall be actually growing, and its fibres obtained, and put into a marketable state, all within a space of 15 minutes. If such rapid means of extraction can be really carried out upon a large scale in practice, the *desideratum* will be reached of effectually meeting the demand for fibrous matter.

The following is an account of the machinery employed by Dr. Stewart West, of Jamaica, who obtained the premium some years ago offered for the best specimen of plantain fibre.

"In order to fulfil the intentions of the honourable House of Assembly, I propose to myself to find out the most simple and expeditious process possible for manufacturing hemp from the plantain tree, that the general adoption of it might not be prevented by complex machinery, or tedious and difficult manipulation.

"I have now to give the result of my inquiries, and have to describe such a simple and easy process, as will enable any person to set on foot a manufacture of hemp, without much trouble or expense. The instrument I have employed is so simple, that a carpenter may make it in half-an-hour, and the whole process is so expeditious, that the hemp may be rendered fit for sale in a few hours after the trees are cut down: I mean the *undressed* hemp; for to dress it with a heckle, unless it were likewise spun and wove in the country, would be quite foreign to the purpose. The process of heckling is by no means so simple as it appears to be: and I can truly affirm that if a person, not bred to the business, attempt to heckle flax and hemp, he will convert the greater part of it into tow; besides, different modes of dressing are necessary, according to the manufacture to which the hemp is to be applied. That part of the process, therefore, can be executed better, and to much greater advantage, in Britain. But if the instrument be in good order, and proper attention be paid to the manufacture, the hemp will be rendered so clean as, in a great measure, to supersede the use of the heckle especially for cordage.

"Though the filaments of the plantain-tree are naturally large, yet they are divisible, and may, therefore, by dressing, be adapted to the manufacture of the finest fabrics, perhaps, to which flax and cotton can be applied. The division of the filaments, however, would be prejudicial in the manufacture of cordage; for, it appears, from an experiment of Count Rumford, that the agglutination of the fibres greatly increases their strength.

"Directions for Making the Cramp.—Take a plank, six feet long, one foot wide, and two inches thick, set one end two feet deep in the ground, and apply a brace before to keep it steady; cut a notch on the top, six inches deep, and eight inches wide; notch the two uprights, half-an-inch wide, to admit the jaws, which must be made of hard wood, the lower one twelve, the upper twenty, inches long; the lower is fixed, the upper is moveable on a pin at one end, and has a weight suspended at the other, which may be increased or diminished at pleasure. The upright, in which the upper jaw turns on the pin, may have a mortice, five inches long, in place of a notch, and two inches may be cut off from the other upright. The jaws are half an inch thick, and two inches wide, brought to an edge where they meet, which must be slightly serrated. If the jaws are made of steel, a quarter of an inch in thickness will be sufficient."

From plants of a ligneous nature, fibre may be obtained, without machinery, by macerating the shoots until the cuticle or outer bark disadheres fairly from the epidermis or true bark; the latter will then separate readily from the ligneous part, and requires but little labour or knowledge to wash, dry, and pack the fibre for market. For the plantain, penguin (*Bromelia pinguin*), and all similar herbaceous plants, machinery is absolutely necessary to separate and clean the fibre advantageously.

The preparation of the pine-apple fibre is exceedingly simple. If a leaf of this plant be examined, it will be found to consist of an assemblage of fibres running parallel from one extremity of the leaf to the other, imbedded in the soft pabulum. All the process necessary is to pass the leaf under a "tilt hammer," the rapid action of which in a few seconds completely crushes it, without in the slightest degree injuring the fibre, which remains in a large skein, and then requires to be rinsed out in soft water to cleanse it from its impurities, and to be afterwards dried in the shade. So simple and so rapid is the process, that a leaf, in a quarter of an hour after being cut from the plant, may be in a state fit for the purposes of the manufacturer, as a glossy white fibre, with its strength unimpaired by any process of maceration, which by inducing partial putrefaction, not only materially injures the strength of the flax, but also renders it of a dingy colour.

In Singapore, where there are several thousand acres covered with this fruit, the process of extracting and bleaching the fibres is exceedingly simple. The first step is to remove the fleshy or succulent side of the leaf. A Chinese astride on a narrow stool, extends on it, in front of him, a pine-apple leaf, one end of which is kept firm by being placed beneath a small bundle of cloth on which he sits. He then, with a kind of two-handled plane made of bamboo, removes the succulent matter. Another man receives the leaves as they are planed, and with his thumb-nail loosens and gathers the fibres about the middle of the leaf, which enables him by one effort to detach the whole of them from the outer skin. The fibres are next steeped in water for some time, after which they are washed, in order to free them from the matter that still adheres and binds them together. They are now laid out to dry and bleach under frames of split bamboo. The process of steeping, washing, and exposing to the sun is repeated for some days until the fibres are considered to be properly bleached. Without further preparation they are sent into the town for exportation to China.

Mr. Underwood, of Madras, has recently invented two simple and effective machines for cleaning fibre, one a cheap modification of the brake, and the other a grooved cylinder press, covered with sheet iron, by which the juice is removed, and the fibre afterwards becomes soft, pliant, and fit for weaving. It is probable that this thick, viscid, milky juice gives to the aloe and other fibres its tendency to rot when much exposed to moisture. Major Maitland is also reported to have invented a fibre-cleaning machine, which is incidently mentioned by the jury of the Madras Local Exhibition, but I have met with no description of it.

Many attempts have been made from time to time to construct a suitable machine for cleaning the New Zealand flax, but comparatively small success has yet attended these efforts. The Baron De Thierry and Mr. Alzdorf, of Auckland, Mr. Nathas, of Nelson, and Mr. Hill, of Sidney, all professed to have discovered machines and processes of great value, but they seem to have died away. The successful employment of efficient machinery would furnish the New Zealand flax dressers with almost inexhaustible supplies of a material admirally adapted for the manufacture of not only canvas and cordage, but of linen, cambric, paper, and other textile fabrics.

A few years ago, favourable mention was made at Auckland, of a machine, the invention of Mr. Whytlaw, for the purpose of separating the fibre from the pulpy cuticle of the *Phormium tenax.*

Hitherto, notwithstanding the industry and ingenuity that has been directed towards the desired end, the endeavour to bring this flax to market in a cleaner and more commercial shape than that which the natives have been in the habit of doing, has proved, for all practical purposes, an absolute failure. Mr. Whytlaw, it was thought, had laid the foundation of a discovery which might be improved upon, and be the eventual means of creating a very large demand for the New Zealand flax.

The natives, and, we believe, every previous experimentalist, in decorticating the flax leaf, applied their machinery so as to act longitudinally on the leaf. After much consideration, Mr. Whytlaw felt convinced that this principle was erroneous, and that the leaf should be subjected to a transverse action. In this belief he was subsequently more fully confirmed from noticing that wherever the growing flax had been bitten by cattle, that there the fibres and filaments of the flax were effectually separated and exposed, and this, in the projector's opinion, because of the circular sort of action of the tongue and jaw of the ox.

Armed with the suggestion thus furnished, Mr. Whytlaw proceeded to reduce his theory to practice. His first machine was made of the hard woods of the colony, and by its assistance he was enabled to dress a sufficiency of the green leaf for transmission to the Great Exhibition in London. But the wooden grooves of the machine were found to operate ineffectively, owing to their becoming easily clogged. They were, therefore, replaced by others of brass.

The manner of divesting the leaf of its cuticle is simple, and notwithstanding the flax which was operated upon was not of that kind which the natives would clean, still the facility with which the pulpy matter is got rid of, and the extreme regularity with which the fibre is set free, were most satisfactorily demonstrated. The leaf is passed longitudinally between fluted surfaces, the one surface acting upon the other diagonally, and thereby completely separating the various fibres—no loss of material, as in the native process of scraping ensues, nor are the fibres liable to kink or become twisted together, after the pig-tail fashion; on the contrary, they hang together smoothly and regularly, and the only further process preparatory to packing and shipping is the washing and drying of the commodity obtained.

Although there had been much chemical experimentalizing in the colony to discover the means of freeing the flax from the gum with which it is incorporated, the scientific persons in Scotland with whom Mr. Whytlaw has been in communication strongly advise no such attempts being made. "Send us the fibre," say they; "we have discovered the chemical solvents which you are in search of, and we can apply them much more effectually and economically than you."

The chief drawback to Mr. Whytlaw's machine lies in the necessity of supplying the feeders *manually*, and these with but a single leaf each at a time. This, if an insurmountable obstacle, would tend to augment the cost of production, and contract the amount of supply, but as we consider that the principle of the operation is almost all that has hitherto been discovered, there can be no question that mechanical means of feeding the machine will ere long suggest themselves.

I have not heard whether this machine has come into general use and been found practically efficient for the purposes intended or not.

Proceedings of Institutions.

Chelmsford.—On Wednesday, the 5th inst., the members of the Literary aud Mechanics' Institution were favoured with a lecture from Mr. John Bennett, F.R.A.S., on "The Birth, Parentage, and Education of a Watch;" a subject apparently dry in itself, yet, by tact and judg-

ment, rendered highly interesting by the lecturer. Mr. Bennett commenced by alluding to the sun-dial of the ancients, and then progressed up to the pendulum and wheelwork of Galileo. The difficulties encountered in the correct measurement of time by the alternate expansion and contraction of the metals, and the different modes practised to counteract this, finally resulting in the elegant and accurate contrivance of the Mercury pendulum of the present time, were simply and effectively told. As an instance of the perfection of the modern astronomical clock, it was stated that a variation of *one beat* in six days would be sufficient to occasion the rejection of such instrument for the purposes required. The adaptation of the larger machine, to the size convenient to be carried about the person with comfort—the difficulties met with, and how surmounted, one by one, formed an interesting feature of the lecture. The excellence of English manufacture was considered to be unsurpassed, and it was stated that all improvements and discoveries of any moment, in time-keepers, since the days of Galileo, have been made by Englishmen. At the conclusion of the lecture, a vote of thanks was passed to Mr. Bennett, on the motion of the chairman, Major Skinner, R.A.

Hereford.—The first *soirée* of the present session of the Literary and Antiquarian Society was held on Tuesday evening, the 4th inst. Mr. Jelinger C. Symons, president of the Society, occupied the chair. The Chairman having briefly opened the proceedings, introduced the Rev. John Emeris, of Gloucester, who read a lively and amusing sketch of "Public Men and Public Affairs in England in 1755." Beginning with the King, George I., then in the 72nd year of his age and the 29th of his reign, the lecturer first remarked on his personal appearance and manners, and then spoke of his bravery, which was undisputed. The first memorable action of his life was to serve under Marlborough, at Oudenarde, in 1708. Thirty-five years later, when 60 years of age, and after he had been long on the throne, he took part in the battle of Dettingen. These fighting days he is fond of recollecting. He is very methodical; rises early; dines early, and then goes to bed for an hour. He spends the evenings in his daughters' apartments, where, with a select company, he plays at cards. His actions are not always kingly, and people about the Court says he is penurious. He is Elector of Hanover, and is fonder of that country than of all Great Britain and Ireland put together. Within one week after the prorogation of Parliament, he leaves London for Hanover, and spends five months there. During his absence, the direction of affairs is entrusted to twelve Lord Justices. The first was his only surviving son William, Duke of Cumberland, afterwards known as the popular "Old King." The rest are for the most part distinguished by wealth and the possession of office, but not by any brilliant talents. Two, however, must be excepted. One of these is the Lord Chancellor, Philip Yorke, Earl of Hardwicke, who starting in life as the son of a Devon attorney, was made Solicitor-General six years after he was called to the bar, when only thirty years of age. He has now the custody of the great seal, which he has held for eighteen years, and a twelve month ago he was created an Earl. Of his judgments only three were called in question, and each of these was confirmed on an appeal by the Upper House. Amongst the members of the Cabinet is Thomas Pelham, Duke of Newcastle, First Lord of the Treasury, Prime Minister to the King, and leader of the House of Lords. His only genius is for deception and intrigue. After briefly sketching the Earl of Chesterfield, the lecturer passed on to consider the distinguished Commoners. The leader here is the Right Hon. Henry Fox, who became on the 14th of last month Secretary of State, and Ministerial leader of the House of Commons. From unpopular Henry Fox, the lecturer passed to brilliant William Pitt, now forty-seven years of age, during the last twenty of which he has been M.P., and for the last nine Paymaster of the Forces. In this capacity he was consulted by Mr. Legge, then Chancellor of the Exchequer, as to some subsidiary treaties which the king had made when on the Continent, with the Landgrave of Hesse and the Empress of all the Russias. Pitt is resolute against the payment, and about a fortnight ago was dismissed from his office. Popular feeling, however, is with him, and next year he must be called back to take the most leading part in the king's Council. During the Session, the Lords Spiritual and Temporal, as well as the Knights of the Shires and Burgesses in Parliament assembled, passed no act for which, as permanently touching our home interests, they deserve any thanks. The lecturer concluded by reading an account of the great earthquake at Lisbon.—After tea, the Chairman called on the Ven. Archdeacon Freer to deliver his lecture on "Ancient Fictile Vases." Few remains of antiquity, he said, had excited more interest than vases, owing to the variety and elegance of their forms, the beauty of the compositions with which they are adorned, and the important instruction which the subjects of those pictures convey. By attentively studying them, the scholar has been enabled to throw much light on the mythology, the history, and the customs of the ancients; the artist has derived high improvement from copying beautiful designs; and the manufacturer, by imitating their forms, has materially improved the shapes of many of those vessels which minister to the comforts and elegancies of life. Vases such as those before the meeting were long called Etruscan, from having been discovered first in Etruria (now Tuscany); but M. Wincklemann showed the absurdity of calling by that name articles found so plentifully in various parts of Italy, as well as in Sicily and Greece. The more proper denomination is certainly "Greek," but looking at the fact that these vases had been found in other countries than Greece, M. Visconti had suggested the name of Græco-Italic or Italo-Greek. Passing to the collection before them, the lecturer observed that they ranged in date from the 5th or 6th to the 2nd century before the Christian era. Vases were employed for a variety of purposes, both domestic and sacred. In the temples, some were used to contain the lustral water for purification; others to receive the blood of the victim; and others to hold the consecrated wine to be poured on its devoted head. Those in the form of bottles with long necks seem to have contained the oil to feed the lamps which burned before the shrines of the gods; while others served for the presentation of the first fruits of the harvest, or of the vine, or of flowers, by the grateful worshippers. Many were to be seen in the Lariaries, or domestic chapels; and others were used in the Eleusinian mysteries, were carried in public processions, were given at prizes in races and gymnastic sports, were customary presents to friends, to a mother on the *dekate*, or tenth day, when the child was named, or to a youth upon his leaving off the dress of a child, and assuming that of a man. They were also used in the baths, at feasts, and for decorations in halls or gardens. Their preservation in such numbers is due to their being deposited in tombs. The figures upon vases or other vessels are generally of a reddish colour, sometimes relieved by white and black, upon a dark or black ground; but in some of the oldest vases the figures themselves are black, and the ground yellowish red. In those of the latest, blue, white, and other colours are used, the ornaments becoming more elaborate and the forms less pure and beautiful. The following, by Monsieur D'Hancaville, which is founded upon the examination of various specimens, seems to have been the manner in which they were made:—"The earth or clay was extremely light and porous, and of a yellowish red colour, when made and dried; but probably previous to undergoing the action of fire, some instrument rather hard, and capable of containing a portion of black liquid pigment of a certain consistency, was employed by the artist in drawing the outline of the figures and composition. * * * * The artist then, probably with a brush, laid on a coat of the black close to the outline, of a certain width, and some inferior person filled up the other parts. * * *

They were then done over, perhaps, with a sort of varnish with a reddish tint, with but little polish, some scarcely with any, although the later vases, and those found at Nola, Capua, and Naples have a most perfect and enduring gloss." The lecturer concluded by alluding to the Portland Vase, which cannot, indeed be called "fictile," in the more confined sense of that word, as being formed upon the potter's wheel, but is of glass, and, therefore, blown, though afterwards worked upon the lathe. The lecture was illustrated by a very beautiful and varied collection belonging to the Ven. Archdeacon. The vases were of all sizes, from the large "krater," or cup for holding wine and water at feasts, capable of holding a gallon, and the "amphora," or water-jug of similar capacity, down to the small "lekythos," designed to hold oil for the sepulchral lamp, and the even smaller vase intended to hold perfumes or unguents for the toilet-table. On the proposition of the Very Rev. the Dean of Hereford, the President presented the best thanks of the meeting to Archdeacon Freer for his most able and interesting lecture. The vote having been suitably acknowledged by the Ven. Archdeacon, the meeting broke up.

To Correspondents.

Erratum.—Mr. P. L. Simmonds has pointed out the following typographical error in his letter in the last Number of the *Journal*. Page 75, col. 1, line 44, for *Prussia* read *Persia*.

MEETINGS FOR THE ENSUING WEEK.

Mon. Actuaries, 7.
London Inst., 7., Mr. Charles Cowden Clarke, "On the Genius and Comedies of Molière."
Tues. Pathological, 8, Anniversary.
Wed. London Institution, 3, Mr. Robert Grant, "On Elementary Astronomy."
Pharmaceutical, 8.
Thurs. London Inst., 7, Dr. R. E. Grant, "On the Natural History of Animals."
Photographic, 8.
Fri. Botanical, 8.
Sat. London Inst., 3, Mr. T. A. Malone, "On the Elementary Principles of Animal and Vegetable Chemistry."

PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette December 21st*, 1855.]

Dated 6th September, 1855.

2018. Charles Pryse, Birmingham, and Paul Cashmore, West Bromwich—Improvements in repeating fire-arms.

Dated 18th October, 1855.

2336. Samuel Statham, Islington—Improvements in electric telegraph cables.

Dated 13th November, 1855.

2550. Robert Tempest and James Tomlinson, and Richard Hampson, and John Hampson, Rochdale—Improvements in looms for weaving, which improvements are applicable to working the valves of steam-engines.

Dated 19th November, 1855.

2599. Thomas Culpin, 25, Royal-hill, Greenwich—Improved apparatus for regulating the supply and discharge of fluids and gases.
2601. Josiah Pratt, Bath-street, City-road, and Thomas Radcliffe, Shaftesbury-street, Hoxton—Improvements in the manufacture of brushes.
2603. John Silvester, West Bromwich—Improvements in steam guages and safety valves.
2605. John McNichol, Manchester—Improvements in machine or cylinder printing.
2607. Michel Pierre Alexis Gilardeau, 39, Rue de l'Echiquier, Paris,—A new motive power.

Dated 20th November, 1855.

2609. Theodore Schwartz, New York—Improvements in drying, heating, and melting solid and plastic bodies.
2611. George Geyelin, 13, Melville-terrace, Torriano Avenue, Camden-road—Propelling vessels by means of pistons, which he calls anti-friction propellers, to supersede paddle wheels, screws, and all other contrivances at present in use.
2613. Francis Puls, Soho-square—A new electric light and heat.
2615. Peter Armand le Comte de Fontaine Moreau, 4, South-street, Finsbury—Improvements in apparatus for preventing horses from running away. (A communication.)
2617. Edward Orange Wildman Whitehouse, Brighton—Improvements in electro-telegraphic apparatus, parts of which are also applicable to other purposes.
2619. David Simpson Price, 2, South Moulton-street, and Edward Chambers Nicholson, 3, Newington-crescent—Improvements in the manufacture of cast steel.
2621. George Senior Tolson, Robert Henry Tolson, and Joseph Senior Tolson, Dalton, Kirkheaton, York, and Thomas Irving, Mold-green, Dalton—Improvements in producing metallic lustre to yarns and fabrics. (A communication.)

Dated 21st November, 1855.

2625. Armand Jean Baptiste Louis de Marcesheau, Paris—Improvements calculated to increase the efficiency or working power of steam engines.
2627. William Munslow and Henry Wallwork, Miles Platting—Improvements in railways.
2629. Thomas Wright Gardener Treeby, 1, Westbourne-terrace Villa, Westbourne-terrace North, Paddington—Improvements in revolving fire-arms.

Dated 22nd November, 1855.

2631. John Roberts, jun., Whitechapel-road—A machine or apparatus for cooling tobacco during the process of manufacture.
2633. Edmund Calvert, and Sidney Ashton Smith, Walton-le-Dale—Improvements applicable to carding engines.
2636. Frederic Lotteri, Bergamo, Lombardy—Obtaining fibre from the bark of trees of the morus family or class, and the application thereof to the manufacture of paper and textile materials, and for other useful purposes.
2637. Charles Tennant Dunlop, Glasgow—Improvements in the manufacture or production of artificial oxide of manganese.
2639. Charles May, Great George-street, and Paul Prince, Derby—Improvements in the manufacture of spikes and trenails.

Dated 28th November, 1855.

2690. James Walker, Leeds—Improvements in the manufacture of textile fabrics.

Dated 1st December, 1855.

2696. Charles Maybury Archer, 3, St. James's-gardens, and Haverstock-hill, Hampstead-road—A new material for the manufacture of paper, and for the production of textile fabrics.
2710. John Gardner, M.D., 51, Mortimer-street, Cavendish-square—A method of treating tea for economising its use and transport.

Dated 4th December, 1855.

2724. Etienne André Napoleon Brécheux, Paris—Improved axle-tree for carriages.
2726. William Foot, Wellington, Somerset—An instrument for moving and stopping trucks and other carriages on railways.
2728. Jean Davoust, Hotel des Invalides, Paris—Improvements in cartridges. (A communication.)
2730. John Marsh, Nottingham—Improvements in the manufacture of looped and piled fabrics.

Dated 5th December, 1855.

2732. John Moffat, Birmingham—Improvements in the manufacture of metallic spoons, forks, and ladles.
2734. William Nunn, 7, Church-street, Hackney—An improved table, washstand, mirror, &c., combined in one piece of furniture.
2736. William Beatson, Rotherham—Improvements in treating borates of lime and magnesia, and a new composition formed therewith, suitable for glazing and other purposes for which borax has been or may be employed.
2738. William Smith, 82, Margaret-street, Cavendish-square—Improvements in apparatus for regulating the supply of air to furnaces.
2740. Alfred Vincent Newton, 66, Chancery-lane—Improvements in apparatus for dressing cloth. (A communication.)

Dated 6th December, 1855.

2744. William Mosley, Salford—Improvements in machinery or apparatus for stretching and finishing woven fabrics.
2746. John Barrow, junior, Manchester—Improved process of manufacturing soda and sulphuric acid.
2748. Thomas Dunn, Glasgow—Improvements in fire-arms.
2750. John Cornes, Swan-lane—Improved mangle or press, parts of which are applicable to rollers employed for pressure purposes generally.
2752. Johannes Neuenschwander, Berne, Switzerland—Improvements in the process of preparing what is called 'Swiss whey' from milk.
2754. Thomas Russell Crampton, Adelphi—Improvement in furnaces, and in apparatus for supplying fuel thereto.
2756. Frederick Samson Thomas, and William Evans Tilley, 6, Kirby-street—Improvements in producing aluminium and its alloys, and in plating or coating metals with aluminium and alloys composed of aluminium and other metals.

Dated 7th December, 1855.

2758. Jean Joseph Emilien François Kuister, Lyons—Improvements in raw silk winding machinery.
2760. Henry Hart, 5, Waterloo-crescent, Dover—A ship leakage indicator. (A communication.)
2762. James Gardner, Plaistow, and Henry Gardner and John Carey Gardner, Leytonstone-road—Improvements in glasses as applied for the transmission of light.
2764. Charles Lenny, Croydon—Improvements in carriages.
2766. John Allin Williams, Baydon, Wilts—Improvements in machinery or apparatus for cultivating land.